BEAR ATTRACTANT TEST OF THE ALTERNATIVE FUEL RAPE ETHYL ESTER

REPORT OF THE NATIONAL PARK SERVICE
YELLOWSTONE CENTER FOR RESOURCES
BEAR MANAGEMENT OFFICE
YELLOWSTONE NATIONAL PARK

Mark J. Biel
Bear Management Technician

Kerry A. Gunther
Bear Management Specialist

Hopi E. Hoekstra
Bear Management Technician

November 1995

Mark J. Biel
Bear Management Office
Box 168
Yellowstone National Park, WY 82190
(307)344-2162, FAX (307)344-2104

Bear Attractant Test of the Alternative Fuel Rape Ethyl Ester

Mark J. Biel, Bear Management Office, Box 168, Yellowstone National Park, WY 82190

Kerry A. Gunther, Bear Management Office, Box 168, Yellowstone National Park, WY 82190

Hopi E. Hoekstra, Department of Zoology, University of Washington, Box 351800, Seattle, WA 98195-1800

Abstract

In 1994, over 3 million visitors toured Yellowstone National Park (YNP). These visitors, along with park concession and National Park Service administrative vehicles, burned over 7.6 million gallons of gasoline and diesel fuel in the park. Pollution from vehicle emissions can have harmful effects on both human and plant life. YNP, in cooperation with the Montana Department of Natural Resources and Conservation and the U.S. Department of Energy, Pacific Northwest and Alaska Regional Bioenergy Program, is participating in a pilot project to explore and evaluate the use of *100% rape ethyl ester* (*biodiesel*) as a low pollution alternative to diesel fuel in environmentally sensitive areas. Biodiesel emits fewer hydrocarbons and particulates than fossil-based fuels and is derived from renewable resources. Biodiesel contains negligible levels of sulfur and reduces emissions of sulfur dioxide, one of the agents responsible for acid rain. Biodiesel is also part of the natural cycle (i.e., assimilation of CO_2 by plants for growth and development), and could lead to zero net gain in oxides of carbon emissions. The fuel is also biodegradable and will quickly break down, preventing long term damage to soil or water in the event of a spill. YNP is an environmentally sensitive area that brings humans and wildlife, such as grizzly bears (*Ursus arctos horribilis*) and black bears (*Ursus americanus*), into close proximity. Biodiesel fuel is a vegetable oil derivative that smells similar to cooking oil. The exhaust from a diesel engine fueled by biodiesel smells similar to a french fry cooker and thus, could act as a bear attractant. Having bears attracted to vehicles powered by biodiesel could draw bears into park developed areas and roadside corridors resulting in bear-human conflicts (bear-caused human injuries and property damages). This could lead to the potential removal of grizzly bears and black bears from the population. As a result of these concerns, tests were conducted to determine if the raw biodiesel fuel or its emissions were bear attractants. As part of the tests,

net gain in oxides of carbon emissions (Peterson and Reece 1995). The fuel is also biodegradable and will quickly break down (96% in 21 days), preventing long term damage to soil or water in the event of a spill (H. Haines, Mont. Dep. Environ. Quality, pers. commun.). YNP is an environmentally sensitive area that brings humans and wildlife, such as grizzly bears (*Ursus arctos horribilis*) and black bears (*Ursus americanus*), into close proximity. Biodiesel is a vegetable oil derivative that smells similar to cooking oil. The exhaust from a diesel engine fueled by biodiesel smells similar to a french fry cooker and thus, could act as a bear attractant. Having bears attracted to vehicles powered by biodiesel, could draw bears into park developed areas and roadside corridors resulting in bear-human confrontations, bear-caused property damages, and/or bear-inflicted human injuries. This could lead to the potential removal of grizzly bears and black bears from the population. As a result of these concerns, tests were conducted to determine if the raw biodiesel fuel or its emissions were bear attractants.

Methods

Ten captive bears (5 grizzly bears and 5 black bears) housed at Washington State University at Pullman were used to test biodiesel fuel and biodiesel exhaust as potential bear attractants. As part of the test, the reaction of bears to odor of biodiesel fuel and biodiesel exhaust were compared to that of a standard (fresh air) and a known bear attractant (deer meat/dog food), as well as diesel fuel and diesel exhaust (Table 1). Diesel fuel has been used in YNP for decades and has not been known to act as a bear attractant.

The 10 bears tested consisted of both males (n=4) and females (n=6) as well as various age classes and locations of origin (Table 2). Tests were conducted within each bear's regular holding pen. Each pen consisted of a 2.4 m wide by 3.7 m long (8 ft wide by 12 ft long) indoor room connected by an open door to a 2.4 m wide by 5.6 m long (8 ft wide by 18.5 ft long) outdoor kennel (Figure 1). Each pen housed from 1 to 3 bears of the same species. Each outdoor portion of the kennel could be opened to allow access to a 2-1/2 acre outdoor exercise area. However, during the tests access to the exercise area was closed. Test procedures were modified from those described by Cushing (1980, 1983) for testing menstrual odor as a bear attractant. Samples of biodiesel fuel, diesel fuel, and deer meat/dog food, were placed in a bowl in a 10-gallon bucket. The bucket was located approximately 6.8 m (22.3 feet) from the nearest pen and on the other side of a cinder block wall (Figure 1). A fan was placed on top of the bucket which forced the odor from the sample being tested through 15 cm (6-inch) stove pipe into the indoor portion of each pen. For the standard test the fan was placed on an empty 10-gallon bucket and outdoor air was forced through the stovepipe. To divert biodiesel and diesel exhaust from running pickup trucks to the pens, a 10 - 15 cm (4 inch to 6 inch) stovepipe converter was placed on the truck exhaust pipe and then 15 cm stovepipe was hooked up to this and run to the indoor portion of each pen. The trucks were located outside and were 3.7 m (12 feet) from the nearest outside pen (Figure 1). Duct tape was used to seal the seams between the sections of stove pipe for all trials to prevent odor from leaking out before reaching the pen.

Due to the small number of bears available (n=10) and the number of stimuli being

H_{o6} There was no difference in the number of minutes grizzly bears versus black bears displayed agitated behavior to diesel exhaust.

Results

Response To Ambient Air

Nine of 10 (90%) bears reacted with indifference for the majority of the 15 minute trial period that ambient air was pumped into their pens (Table 3). One bear (#B2) displayed attraction/investigation behavior for over half of the trial period and 1 bear (#G5) briefly (6 min) displayed agitation/aggression behavior during the trial. In the case of bear #G5, her 2 cubs of the year (COY) were in the indoor pen playing and sleeping during the trial and she was becoming agitated presumably because the fan noise was loud and she felt her cubs were threatened. The fan was shut off at the request of facility managers for minutes 8, 9, and 10 so the sow could retrieve her cubs from the inside pen and take them to the outdoor portion of the pen. The fan was then turned back on for the remainder of the 15 minute trial period.

Response To Deer Meat/Dog Food

All 10 bears (100%) displayed some level of attraction/investigation behavior when deer meat/dog food was pumped into their pens (Table 4). Three (30%) bears (#'s G3, G4, B1) exhibited a strong attraction as evidenced by licking the vent and walls of the indoor pen. Only 1 (10%) bear (#G1) displayed no reaction for a portion of the trial period. No (0%) bears became agitated/aggressive when this stimulus was presented.

Response To Biodiesel Fuel

Eight of 10 (80%) bears displayed no reaction for the majority of the 15 minute trial with odor from biodiesel fuel pumped into their pens (Table 5). Two of the 10 (20%) bears (#'s G1, B3) displayed attraction/investigation behavior to this stimulus for the majority of the trial.

Response To Diesel Fuel

All ten bears (100%) exhibited no reaction for the majority of the 15 minute trial with odor of diesel fuel pumped into their pens (Table 6). Four of 10 (40%) bears (#'s G5, B1, B3, B4) displayed a small degree of attraction/investigation behavior to this stimulus.

Response To Biodiesel Exhaust

Four of 10 (40%) bears (#'s G3, B2, B4, B5) displayed no reaction for the majority of

no significant difference in the number of minutes either grizzly bears (t=0.33, df=4, P=0.76) or black bears (t=-0.89, df=4, P=0.42) displayed agitation to biodiesel exhaust as compared to diesel exhaust. Grizzly bears displayed significantly more agitation/aggression behavior to both biodiesel exhaust (t=-5.09, df=8, P=0.001) and to diesel exhaust (t=-2.95, df=8, P=0.018) than did black bears.

Discussion

Bears displayed no reaction when ambient air was pumped into their pens and a significant strong attraction/investigation response when the odor of deer meat/dog food (their standard food stuff) was pumped into their pens. In contrast, bears did not display a significant attraction to biodiesel fuel odor, diesel fuel odor, biodiesel exhaust, or diesel exhaust. In addition, there was not a significant difference in bears' reactions to biodiesel fuel odor as compared to diesel fuel odor or to biodiesel exhaust as compared to diesel exhaust. Diesel fuel has been used for decades in YNP without any known significant influence on the number of bear-human conflict situations occurring in the park. These results suggest that biodiesel fuel and biodiesel exhaust are not any more or less of an attractant than are diesel fuel and diesel exhaust. Standard methods used to handle and store hazardous fuels make them largely unavailable to bears. If biodiesel fuel is stored, handled, burned, and spills cleaned-up in the same manner as diesel fuel currently is within YNP, then use of biodiesel fuel would not be expected to contribute to additional bear-human conflicts above existing levels.

Due to budget limitations this study was conducted with facilities and materials available at no cost. In addition, personnel time allocated to this project was also limited by available funding (20 person days total for design, experiment, analysis, poster presentation and final report). Due to these limitations, the study could not be designed to meet criteria required for random and independent tests. However, the 10 bears tested reacted as expected to ambient air (no response) and to deer meat/dog food (strong attraction), suggesting that the study design probably did not significantly alter each bear's reaction to the 4 test stimuli (biodiesel fuel odor, diesel fuel odor, biodiesel exhaust, diesel exhaust).

Potential study biases that may have influenced test results include:

1.) The noise from the fan may have influenced the bears' responses to the different stimuli.

2.) The same hose was used for all trials. There could have been residue of test stimuli left in the hose. However, the hose was flushed with ambient air between trials of different stimuli.

3.) Due to multiple bears being held in a single pen, tests between bears and different stimuli were not random.

4.) The same bears were used to test all stimuli, thus tests were not independent.

5.) Due to multiple bears being confined to a single pen, bears' responses may

Biological Service), and C. Servheen (Grizzly Bear Recovery Coordinator, U.S. Fish and Wildlife Service) for review of and recommendations for the study design; R. Renkin (Management Biologists, YNP) for statistical analysis of the data; and C. Peterson (Department of Agricultural Engineering, University of Idaho) and D. Reece (Department of Agricultural Engineering, University of Idaho) for providing the diesel and biodiesel powered trucks, fuel, fan and stove pipe used in the experiment.

Literature Cited

Cushing, B. S. 1980. The effects of human menstrual odors, other scents, and ringed seal vocalizations on the polar bear. M.S. Thesis, University of Montana, Missoula. 49pp.

Cushing, B. S. 1983. Responses of polar bears to human menstrual odors. Int. Conf. Bear Res. and Manage. 5:270-274.

Environmental Protection Agency. 1992. What you can do to reduce air pollution. U.S. Environmental Protection Agency. EPA Report 450-K-92-002. 21pp.

Peterson C. L., and D. Reece. 1995. On-road testing of biodiesel from rapeseed oil. 1995 Report of Biodiesel Research at the University of Idaho. Department of Agricultural Engineering, Univ. of Idaho, Moscow. 2pp.

Zar, J. H. 1974. Biostatistical Analysis. Prentice-Hall Publ. Co., Inc. Englewood Cliffs, N.J. 620pp.